



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

THE HOUR-GLASS STEMS OF THE BERMUDA PALMETTO.

BY JOHN W. HARSHBERGER, PH.D.

The only indigenous palm of the Bermuda islands is *Sabal Blackburniana* Glazebrook. It grows in all kinds of soil, on the barren hill-sides, on the rocky shores in wind-swept situations and in the inland marshes, such as Pembroke and Devonshire marshes. Along the shores of these islands, in the eolian rocks and on the smaller islets of the Bermuda archipelago, the tree is usually dwarfed with a small crown of yellowish-green leaves. In rich soil, the crown is large and the tree usually reaches a considerable diameter (Plate XLII, fig. 18). When found in the inland brackish marshes, the caudex is tall and flexuous, resembling that of the coconut palm (fig. 22). The height of the Bermuda palmetto varies from fifteen to twenty feet in good soil; in the marshes, it grows from thirty-five to forty feet, while its circumference varies with edaphic conditions. In good soil, the circumference ranges from forty to fifty inches; in the marshes, sixteen to twenty inches. The breadth of the leaf is approximately six to eight feet and the length of the petiole three to seven feet.

The hour-glass constrictions of the trunk, or caudex, is a unique feature of this palm. Mr. Oswald A. Reade, in communication with Sir Joseph Hooker, says of them:¹ "In many individuals the stem is wanting; in others a small stem has apparently been the result of many years' growth, evidenced by the extreme roughness of the trunk, hour-glass contractions and decay. . . . The hour-glass contractions mentioned above are very curious; in one which I measured, the circumference at one foot from the ground was thirty inches; at two feet eight inches, eight inches only; and at three feet, twenty-five inches. In other stunted individuals the stem appears conical, and sometimes as a bulbous expansion close to the ground." The significance of these waist-like constrictions has not been considered by any botanist, and in a study of the few papers dealing with the Bermuda flora, the writer can find no other reference to the hour-glass stems. The object of this paper, therefore, is to describe such caudices and to

¹HEMSLEY, W. BOTTING: Challenger Report. Botany of the Bermudas. *Botany*, I, p. 71.

discover the cause which has produced this absolutely unique kind of palm-stem.

The explanation is found in the manner in which palm stems grow in general and the influence of the meteorologic and soil (edaphic) conditions on the cells of the growing crown. It is a well-known fact that the primary root of all palms soon perishes and is replaced by adventitious roots springing from the base of the stem. It is some years before the stem appears above the surface of the ground. In the meantime, the circumference of the growing point is continually increasing, producing successively larger leaves, so that the much-compressed axis forms an inverted cone, which is kept in position by the numerous adventitious roots. Finally, a rosette of normal-sized leaves is produced and the stem grows erect, forming a cylindric structure, the diameter of which varies widely in different species, but which, once formed, shows no secondary increase in thickness by the formation of new elements, so that the diameter of the stem remains almost uniformly the same from the base to the top of the tree. There is, however, an increase in diameter in the older stems of some palms which causes the gradual tapering upwards which is sometimes observed. This increase is due to the expansion of the parenchymatous fundamental tissue which separates the vascular bundles, accompanied by an increase in the cell-cavity and in the thickness of the walls of the sclerenchymatous fibers which support the bundles.

Evidently, we can explain the hour-glass caudices in the Bermuda palmetto by the general application of principles of palm-stem growth described above. If we remember that the diameter of the cylindric palm-stem is determined by the dividing cells of the rosette, or crown of green leaves, then any environmental condition which influences the growth and division of this terminal mass of meristematic cells influences in a direct way the diameter of the stem. We have already alluded to the fact that the leaves of the Bermuda palmetto in extremely rocky and dry situations are yellowish-green and smaller than those of a tree in correspondingly rich soil. Fig. 9 perhaps best represents a tree found in an extremely dry situation with a trunk that gradually tapers upward, showing that in youth the tree made a rapid and vigorous growth, but that in subsequent years the conditions which have influenced the crown growth of this particular tree have been unusually unfavorable. Now, if we apply this discovery to a study of other trees, many forms of which are figured on Plate XLII, we have the solution of the question concerning the apparent anomalous condition of the stem structure.

Given alternating periods of dry and wet weather, or given conditions which are at seasons prejudicial to the best growth of this palmetto, we would find alternate constrictions and enlargements of the stem in response to the environmental conditions. In seasons favorable to growth, the growing apex of the stem would expand itself with a correspondingly larger crown of leaves and increased diameter growth of the stem. During dry periods, the apex would become contracted, the crown of leaves smaller and the stem diameter correspondingly constricted, or contracted. The stem diameter is controlled by the size of the crown, and the size of the crown is in direct response to the meteorologic, edaphic and physiologic conditions which surround the tree. A comparison of figs. 18 and 12, representing trees growing in wet marshy ground, with figs. 9, 14 and 20, illustrating trees found in dry rocky situations, will show that the statements made above are almost axiomatic.

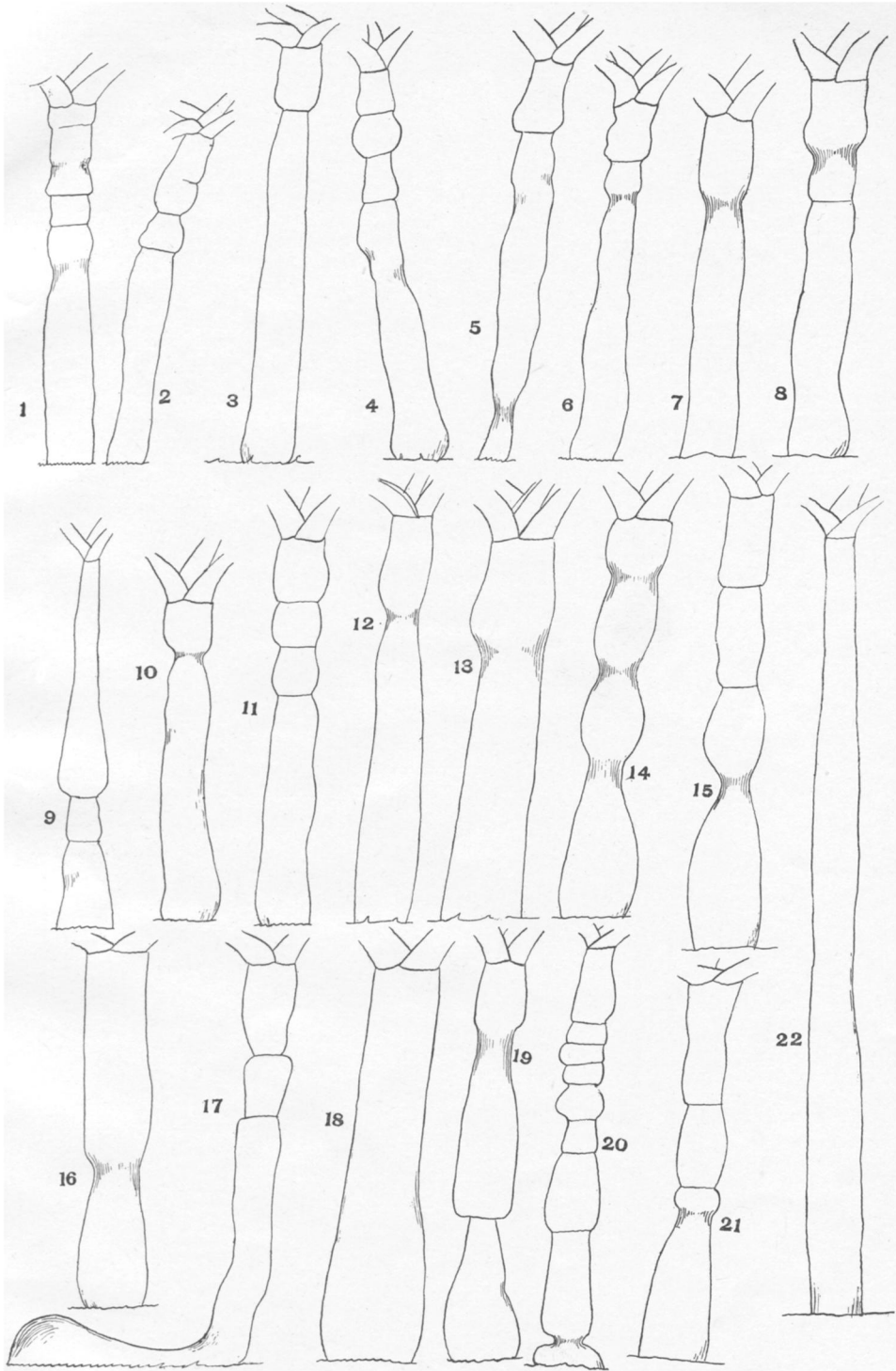
That climate influences the cell growth of palms is illustrated by a specimen in the botanical laboratory of the University of Pennsylvania, presented by S. L. Schumo. It is a section of stem of a *Sabal palmetto* which grew at Daytona, Florida. The cross section shows evidence of two rings of growth outside of the main, uniformly-constructed cylinder of bundles and parenchymatous tissue. The description accompanying the specimen states that the tree from which the section was made shed its leaves in a manner similar to the horse-chestnut, so that the petiole was left attached to the main stem. The statement also is made that the natives claim that the petioles, which they call bootjacks, all fall off and then the trunk becomes bare when this tree becomes mature. It is evident, therefore, that the recurrent fall of leaves from this tree, just as in typical dicotyledonous stems with concentric annual rings of wood, has produced the corresponding stem structure just described—that is the appearance of two well-marked rings, external to the central uniform stem cylinder.

The secondary growth in thickness which we have described for the Bermuda palmetto, where the stem is alternately enlarged and contracted producing the hour-glass forms, is different from the secondary growth in thickness displayed by *Sabal palmetto* in Florida. However, the fact that palms do show secondary growth in thickness renders these examples absolutely unique, as far as the information of the writer goes.

Another fact of somewhat similar import may be mentioned, namely, that the stems of the coconut palm, *Cocos nucifera*, as seen by the writer in Jamaica, and of the Bermuda palmetto, *Sabal Blackburniana*,

as seen by him in Bermuda in June, 1905, contrary to the usual belief that old stems with permanent tissue cannot alter the position of such tissue, will make secondary growth curvatures and will grow again into upright position after they have been blown prostrate to the ground by hurricanes, as illustrated in fig. 17, a drawing of a tree found along the shores of Harrington Sound near Devil's Hole, Bermuda.

The figures sufficiently display the peculiarities of the stem of the Bermuda palmetto, so that a description of each figure is superfluous. It may be said, however, that figs. 1-8 inclusive represent trees growing along the north shore of the main island in front of a golf clubhouse. Fig. 9 pictures a tree found in extremely dry situations. Fig. 14 is that of a tree in a rocky abandoned quarry. Fig. 15 depicts a tree at the edge of a field along the north shore road; fig. 22, a tree in Pembroke Marsh, and fig. 18, a palmetto in rich soil along the edge of this marsh, while fig. 20 pictures the trunk of a tree on the dry cliffs along St. George Harbor. The other figures are drawings of trees, which grew in other parts of the Bermuda archipelago.



HARSHBERGER. CAUDICES OF BERMUDA PALMETTO.